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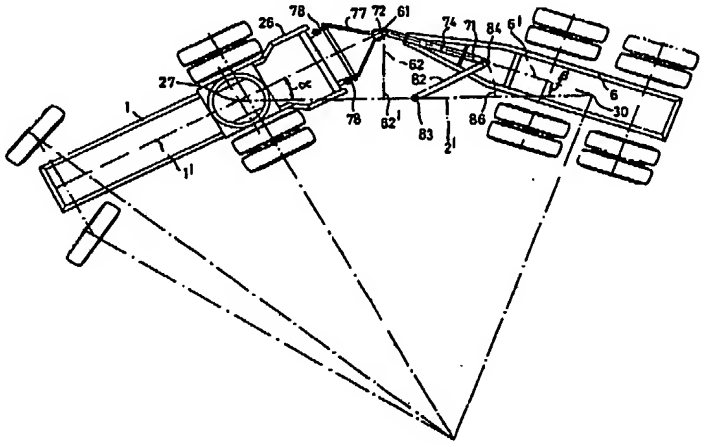
(54) Title: ARTICULATED VEHICLE WITH STEERING LINKAGE



(57) Abstract

A main chassis (2) is supported by two sub-chassis (1, 6). Linkage members (71, 72) are mounted on the respective sub-chassis (6, 1) for movement along their respective median planes (6', 1') and are connected together by a pivot having a pivot axis (61) which lies substantially at the intersection of the median planes (6', 1') during turning of the vehicle. Control means, comprising a link (82), acts on one linkage member (71) so as to control, during turning, the ratio of the angle (α) between the median plane (1') of one sub-chassis (1) and the median plane (2') of the main chassis (2) to the angle (β) between the median plane (6') of the other sub-chassis (6) and the median plane (2') of the main chassis.

substantially at the intersection of the median planes of the two sub-chassis during turning. One member is fixed to the front sub-chassis and the other is movable along the median plane of the rear sub-chassis, so that the rear sub-chassis pivots through a smaller angle than the front sub-chassis during turning. In this arrangement the locus of the pivot axis is an arc of a circle centered on the pivot axis of the front sub-chassis. Thus the ratio between the angle of the front sub-chassis and the angle of the rear sub-chassis increases as the angles increase. This is disadvantageous, since ideally the ratio should be constant.

What is desired is a linkage means which enables the ratio of the said angles to be controlled, preferably to be maintained substantially constant, whether or not the said ratio is equal to unity.

According to the present invention, both of the said members are movable along the respective median planes of the two sub-chassis, and control means act on the first linkage member so as to control the ratio between the said angles by controlling the motion of the first linkage member during turning.

The control means preferably acts on a part of the first linkage member remote from the pivot axis, since the range of movement decreases with increasing distance from the pivot axis.

The control means preferably comprises mechanical guide means mounted on the main chassis. In one possible embodiment the guide means may comprise a transverse guide fixed on the main chassis and guiding a part of the first linkage member; the guide may be accurately shaped to ensure a constant ratio between the said angles. However, in an embodiment preferred for simplicity of construction and adaptability of configuration, the guide means may comprise a rigid link

having one end pivoted about a substantially vertical axis to the main chassis and the other end connected, directly or indirectly, to the first linkage member. When the vehicle turns, the said other end of the rigid link will follow an arcuate path. By suitably selecting the position of the said one end and the length of the rigid link, the motion of the first linkage member can be controlled so that the ratio between the said angles is kept approximately constant. The said one end is preferably pivoted at a point lying within the length of the first linkage member when the said median planes are co-planar.

The second linkage member may be mounted on the said other sub-chassis by a frame having a narrower end pivoted to the second linkage member about a horizontal axis and a wider end connected to the said other sub-chassis by horizontally spaced links whose ends are pivoted about horizontal axes. The links are preferably connected to a further frame, which is pivotable together with the said other sub-chassis about the pivot axis of the said other sub-chassis and is also pivotable together with the main chassis about a horizontal axis.

The invention will be described further, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a schematic plan view of the steering arrangement of an articulated vehicle in accordance with the invention;

Figure 2 is a schematic side view of the steering arrangement;

Figure 3 is an enlarged detail of Figure 2; and

Figure 4 is a schematic side view of part of another vehicle in accordance with the invention.

The vehicles illustrated are of the type described in WO-A-86 01479, having a main chassis 2 pivotally

supported by front and rear sub-chassis 1,6, one of which carries the engine. Constant velocity power is communicated between the sub-chassis 1,6 by an intermediate shaft 20 (Figure 4) connected to a front shaft (not shown) and a rear shaft 21 extending along the respective median planes 1',6' of the respective sub-chassis 1,6. Durning turning of the vehicle, the median planes 1',6' intersect at a point 61 nearer to the pivot axis 27 of the front sub-chassis 1 than to the pivot axis 30 of the rear sub-chassis 6. The universal joints of the intermediate shaft 20 are equidistant from the intersection point 61. The angle α between the median plane 1' of the front sub-chassis 1 and the median plane 2' of the main chassis is thus larger than the angle β between the median plane 6' of the rear sub-chassis and the plane 2'. Ideally the ratio α/β should remain constant; the corresponding ideal locus 62 of the intersection point 61 is shown in broken line in Figure 1.

The linkage illustrated in Figures 1 to 3 is designed to achieve a locus 62' approximating to the ideal locus 62 and comprises a first, elongate linkage member 71 mounted on the rear sub-chassis 6 and a second linkage member 72 mounted on the front sub-chassis 1, the members 71,72 being connected together by a pivot 73 having a vertical axis coinciding with the intersection point 61.

The first linkage member 71 extends along the median plane 6' of the rear sub-chassis 6 and is longitudinally guided by a tubular guideway 74 fixed to the sub-chassis 6. The second linkage member 72 is pivoted about a horizontal axis 76 to the narrower end of a generally triangular frame 77 whose wider end is connected by horizontally spaced links 78 (whose ends are pivoted about horizontal axes 79) to a further frame 26 pivoting with the front sub-chassis 1 about the axis 27 and

pivoting with the main chassis 2 about a horizontal axis 25. The links 78 and the horizontal pivot axes 76,79 allow the member 72 to move along the median plane 1' of the front sub-chassis 1; the maximum extent of movement of the links 78 during turning is indicated by the arc 81 in Figure 3.

The motion of the first linkage member 71 during turning is controlled by a rigid connecting bar 82 whose front end is pivoted about a vertical axis 83 to the underside of the main chassis 2 and whose rear end is pivoted to the rear end of the member 71 about a vertical axis 84. Accordingly the rear end of the member 71 follows an arc 86 centered on the axis 83 during turning. The position of the axis 83 and the length of the bar 82 are selected so that the arc 86 representing the locus of the axis 84 corresponds to the locus 62' of the axis 61 which most closely approximates to the ideal locus 62, i.e. so that the ratio α/β is approximately constant. As shown when the median planes 1',2',6' are co-planar (Figure 2) the axis 83 preferably lies between the point 61 and a point half-way along the member 71.

The swinging bar 82 could be replaced by a curved guide fixed to the underside of the main chassis 2 and cooperating with a sliding element located on the rear end of the linkage member 71. The guide could then be accurately shaped to achieve the ideal locus 62.

Figure 4 shows a modification of the linkage in a situation in which the shaft 20 has to extend above part of the linkage. In this case the links 78 hang from the frame 26 so that the frame 77 is slung below the shaft 20. The rear end of the linkage member 71 is pivoted about a horizontal axis 86 to the front end of an open frame 87 through which the rear shaft 21 descends from the intermediate shaft 20. The rear end of the frame 87 is pivoted about a horizontal axis 88 to an intermediate

point of an upstanding frame 89 whose lower end is pivoted to the rear sub-chassis about a horizontal axis 91 and whose upper end is pivoted about a horizontal axis 92 and vertical axis 93 to the rear end of the swinging bar 82 whose front end is pivoted to the main chassis 2 about a horizontal axis 94 and a vertical axis 96. The positions of the links 78, the frame 87, and the frame 89 during maximum turning of the vehicle are indicated in chain-dotted line at 78',87', and 89' respectively.

Various modifications may be made within the scope of the invention. For instance, it is possible to omit the shafts driving the wheels of the rear sub-chassis 6 and to drive only the non-steering wheels of the front sub-chassis 1. Instead of being mounted on the pivoted frame 77, the second linkage member 72 could be made elongate (like the first linkage member 71) and arranged slidably in a tubular guideway (like the guideway 74) extending along the median plane 1' of the front sub-chassis.

Claims:-

1. An articulated vehicle comprising a front sub-chassis (1) and a rear sub-chassis (6), a main chassis (2) supported by each sub-chassis (1,6) for pivoting about a vertical axis (27,30), and linkage means for inter-relating the pivoting of the two sub-chassis, during turning of the vehicle, so that the angle (β) between the median plane (6') of one sub-chassis (6) and the median plane (2') of the main chassis (2) is a function of the angle (α) between the median plane (1') of the other sub-chassis (1) and the median plane (2') of the main chassis (2), the linkage means comprising a first linkage member (71) mounted on the said one sub-chassis (6) and a second linkage member (72) mounted on the other sub-chassis (1), the said members (71,72) being connected together by a pivot having a vertical pivot axis (61), the mounting of the said members (71,72) being such that the pivot axis (61) is constrained to lie substantially at the intersection of the median planes (1',6') of the two sub-chassis (1,6) during turning, both of the said members (71,72) being movable along the respective median planes (6',1') of the two sub-chassis (6,1), and control means acting on the first linkage member (71) so as to control the ratio (α/β) between the said angles (α,β) by controlling the motion of the first linkage member (71) during turning.

2. A vehicle as claimed in claim 1, in which the control means acts on a part of the first linkage member (71) remote from the pivot axis (61).

3. A vehicle as claimed in claim 1, in which the control means comprises mechanical control means mounted on the main chassis (2).

4. A vehicle as claimed in claim 3, in which the guide means comprises a rigid link (82) having one end pivoted about a substantially vertical axis (83;96) to the main chassis (2) and the other end connected, directly or indirectly, to the first linkage member (71).

5. A vehicle as claimed in claim 4, in which the said one end is pivoted to the main chassis (2) at a point lying within the length of the first linkage member (71) when the said median planes (1',6') are co-planar.

6. A vehicle as claimed in claim 1, in which the second linkage member (72) is mounted on the said other sub-chassis (1) by a frame (77) having a narrower end pivoted to the second linkage member (72) about a horizontal axis (76) and a wider end connected to the said other sub-chassis (1) by horizontally spaced links (78) whose ends are pivoted about horizontal axes.

7. A vehicle as claimed in claim 6, in which the said links (78) are connected to a further frame (26), which is pivotable together with the said other sub-chassis (1) about its pivot axis (27) and is also pivotable together with the main chassis (2) about a horizontal axis (25).

8. A vehicle as claimed in claim 1, in which at least one of the linkage members (71,72) is longitudinally slidable in a tubular guideway (74) extending along the median plane of the corresponding sub-chassis.

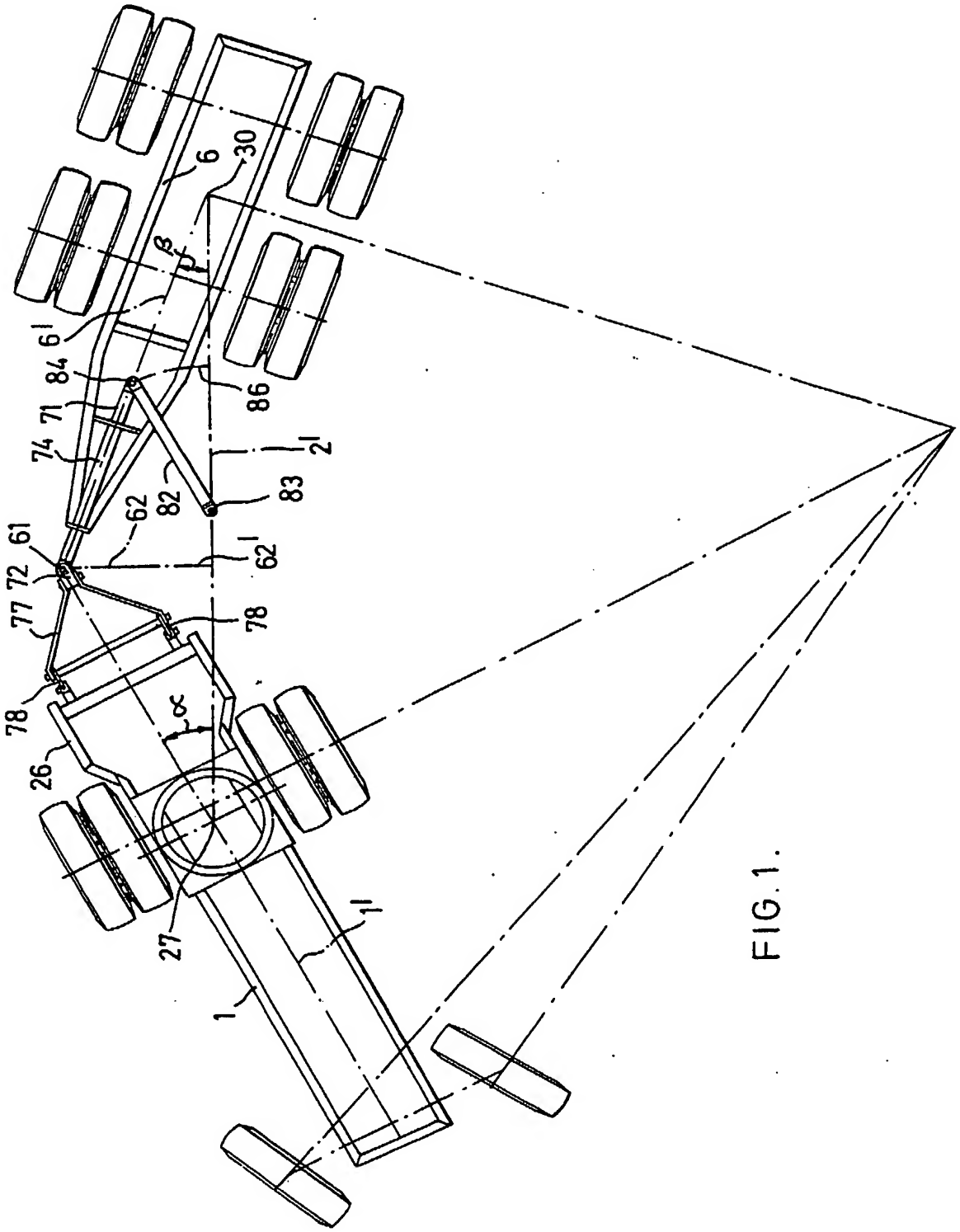


FIG.1.

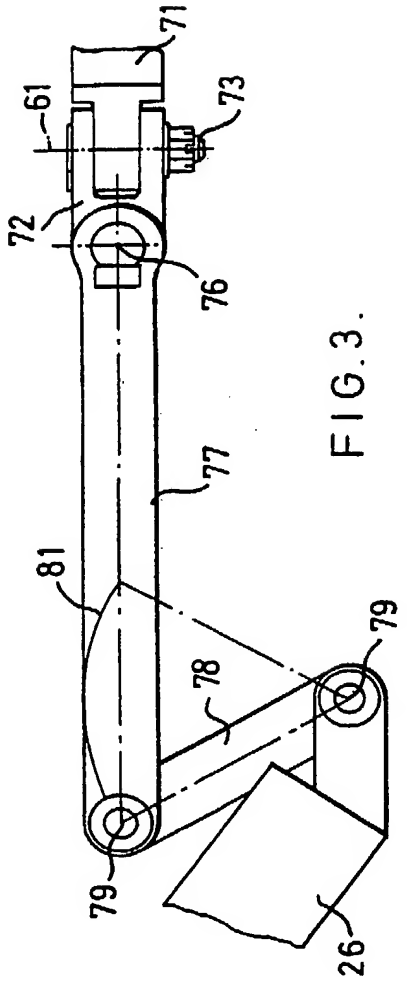

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FIG. 3.

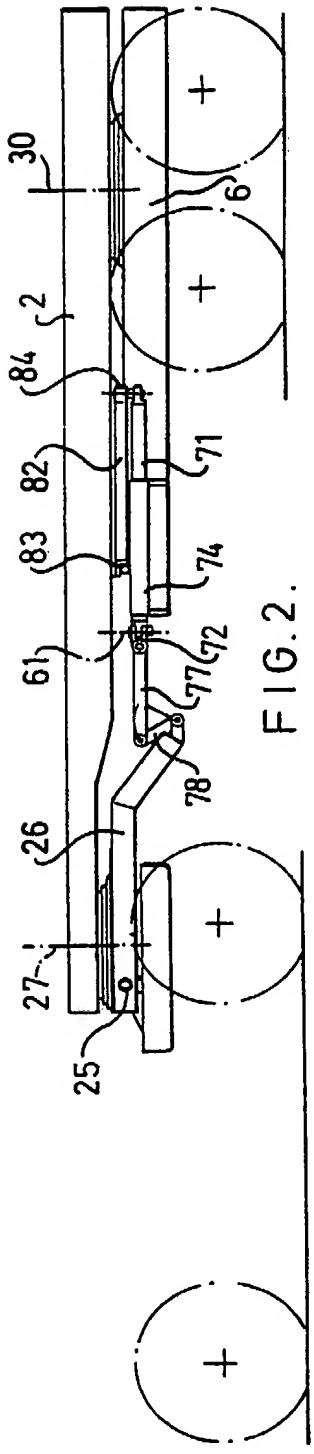
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FIG. 2.

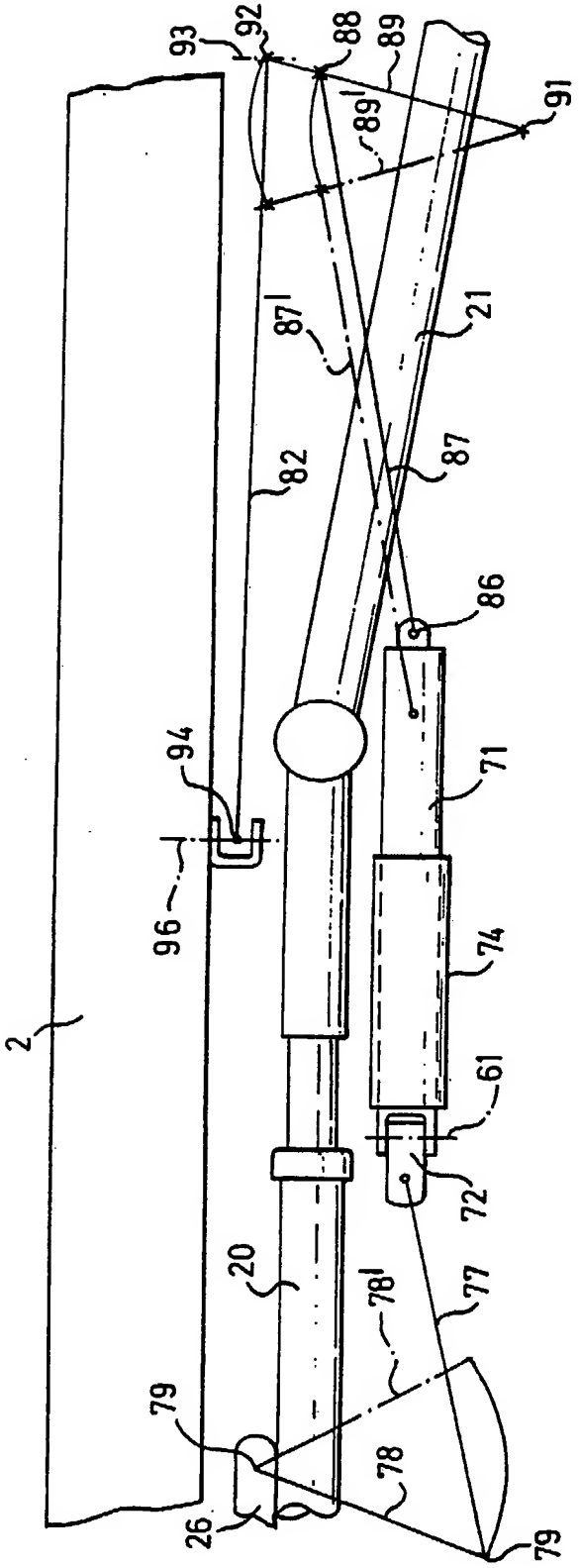

FIG.4.

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 89/00667

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[5]: B 62 D 53/00, B 62 D 13/02

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[5]	B 62 D

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
A	CH, A, 388111 (ACKERMANN-FAHRZEUG BA) 31 May 1965, see figures 1-3; page 2, lines 73-91 --	1
A	FR, A, 2518950 (P. COMTE) 1 July 1983, see figures 1,2; claim 1 --	1
A	CH, A, 352241 (INVENTIO AG) 30 March 1961, see figures; page 2, lines 49-79 ----	1

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
15th September 1989	09. 10. 89
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	T.K. WILLIS

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. GB 8900667 SA 29641

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 04/10/89
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CH-A- 388111		None	
FR-A- 2518950	01-07-83	None	
CH-A- 352241		None	